# Chapter 1
# Introduction

## 1-1. Purpose

*a*. This engineer pamphlet (EP) provides geotechnical, chemical, microbial, and operational guidance for U.S. Army Corps of Engineers (USACE) elements in identifying aspects of groundwater extraction and injection wells and systems that have led to failures of either the extraction and injection wells or related piping and treatment systems at hazardous, toxic, and/or radioactive waste (HTRW) sites. These guidelines are a compilation of specific problems that have been identified in each of several categories, along with a technical discussion of their diagnoses and solutions.

*b*. This EP provides the multidisciplinary guidance needed to:

(1) Sustain the performance of ground water extraction and injection systems so that site mission (ground water cleanup) failure does not occur.

(2) Delay substantial, radical rehabilitation of these systems as long as possible.

*c*. This EP will provide:

(1) Background and rationale for well maintenance problems.

(2) Demonstrated prevention and remedial methods for wells.

(3) Specific guidance in applying solutions.

*d*. This background and associated recommendations will be based on experience and applied research by USACE, its contractors, and other experienced parties.

*e*. The USACE and the programs it oversees in HTRW ground water remediation have the responsibility to ensure that the projects fulfill their mission of cleaning up ground Water to the extent necessary (defined by risk analysis or legal maximum contaminant levels (MCLs)) to protect human health and the environment where technically feasible. Pumping and injection well systems are integral parts of these efforts on many sites. It is the management's responsibility to ensure that well systems installed continue to function at the optimal level.

## 1-2. Applicability

This EP applies to all USACE Commands having Civil Works and/or Military Programs HTRW project responsibilities.

## 1-3. References

Required and related publications are listed in Appendix A.

## 1-4. Distribution Statement

Approved for public release; distribution is unlimited.

## 1-5. Safety

Personal safety is the top priority in any operations on HTRW sites. The guidance in this EP is provided with safety in mind. However, users of this pamphlet are responsible for following the requirements of EM 385-1-1 and ER 385-1-92.

## 1-6. Scope and Application

*a. Scope*. This EP is concerned with the operation and maintenance (O&M) of ground water injection and extraction systems on HTRW sites; however, it does not address the rehabilitation of these systems (that is, the actions taken to restore a well after substantial loss of performance), although maintenance operations will have some similarities with rehabilitation. The scope also excludes the O&M of the water treatment plant facility. Other pumping or injection wells besides those at HTRW sites (for example, ground water monitoring wells or water supply and injection wells for purposes other than HTRW cleanup) have performance and water quality problems associated with well deterioration. Also, monitoring wells (for either HTRW or preventive monitoring) may become clogged and no longer provide reliable samples for water quality analysis. While not specifically addressed to these applications, many features of the diagnosis and maintenance treatments will also apply to these other wells.

(1) Performance. This EP will emphasize the role of preventive design and construction (based on good quality data and practice) in preventing or delaying problems. It is assumed that wells on HTRW sites will

- operate under conditions that often promote rapid well performance deterioration.
- need to be designed and operated in such a way that unavoidably promotes well performance problems.

(2) Effects of past design and maintenance. The EP also addresses situations where installation operators are required to maintain well systems that were not optimally designed in the first place. In studying the operating challenges of such systems, it has become apparent that some O&M practices for HTRW site well systems are ineffective, and obsolete processes are being followed that do not reflect modern understanding of microbial and geochemical processes. This EP is intended to provide guidance to update O&M processes, taking into consideration modern understandings to improve O&M effectiveness.

*b. Application*. The specific application of and adherence to these guidelines must be tailored to each project function, the contaminants of concern, the adopted treatment solution, local geohydrologic properties, geotechnical judgment, available resources, applicable regulatory requirements, policy and guidance, public concerns, and remediation goals.

## 1-7. Terminology

Communication between regulatory, oversight, owner, and contractor personnel involved in the remediation of an HTRW site is important both before and during remediation of the site. Communication is complicated by the involvement of numerous technical disciplines and regulatory agencies, and it is imperative that the descriptive language used during discussions be compatible. Likewise, the practices of well design, construction, and maintenance and rehabilitation also have specific terminology and usages. This EP promotes an interdisciplinary approach to well-system design and O&M that works to enhance system performance. The reader is assumed to be a technically competent person who may not be familiar with all specific terminology usages, but has a general but not thorough knowledge of ground water and well-system construction. Therefore, a wide range of definitions will be supplied to promote clarity.

*a. Definitions*.

(1) EM 1110-1-4000 provides definitions for terms in the following topical areas:

- Drilling and well installation plan/drilling plan.
- Field activity (FA).
- Field drilling organization (FDO).
- Geotechnical data quality management.
- Hazardous and/or toxic waste.
- Well redevelopment/rehabilitation.
- Screened interval.
- Site Safety and Health Plan (SSHP).
- Well development.

(2) Additional industry (e.g., National Groundwater Association, American Water Works Association (AWWA) Research Foundation, American Society for Testing and Materials (ASTM)) and international sources of definitions were used in preparation of this pamphlet. Several relevant documents provide lists of definitions specific to the O&M of wells, particularly Borch, Smith, and Noble (1993), Cullimore (1993), Driscoll (1986), Helweg, Scott, and Scalmanini (1983), Smith (1992), and Alford and Cullimore (1999). ASTM Standard Guides cited herein (e.g., D 5978, Standard Guide for Maintenance and Rehabilitation of Ground-Water Monitoring Wells) also provide definitions of specific terms used.

(3) Some technical terms have come to be commonly used in specific ways in well maintenance activities and are frequently used in this pamphlet. Most of these relate to causes of problems. Others are used in specific ways in this pamphlet and are defined in Appendix B.

## 1-8. Basis

The basis for the information and recommendations contained in this pamphlet is experience in actual operations. Relevant case history information is published in Leach et al. (1991); Smith (1995); and Alford and Cullimore (1999).